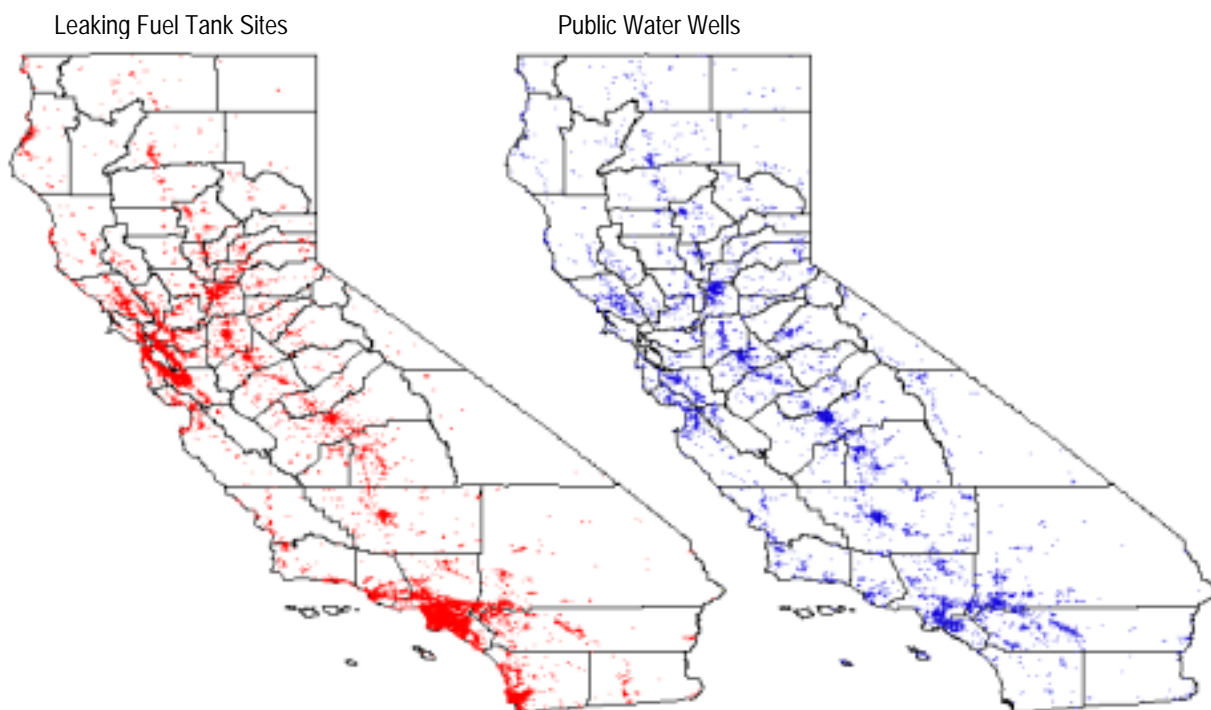




Evaluating the Feasibility of a Statewide Geographic Information System

Design and Testing of an Internet Accessible Geographic Environmental Information Management System



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Report Submitted to:

California State Water Resources Control Board

July 1, 1999

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1. Legislative Mandate

In February 1997, Assembly Bill 592 (Assemblymember Sheila Kuehl) and Senate Bill 1189 (Senator Tom Hayden) were introduced to determine the feasibility of creating a Statewide geographical information system (GIS) to assess the vulnerability of public drinking water sources from fuel hydrocarbon releases and to assist in managing the public health risk that may be associated with these releases. These bills were introduced following the contamination with the fuel additive MTBE (methyl tertiary-butyl ether) and subsequent closure of drinking water wells supplying the City of Santa Monica, and with the realization that leaking underground fuel tanks (LUFTs) may threaten other drinking water wells throughout the state. Assembly Bill (AB) 592 and Senate Bill (SB) 1189 were signed by Governor Pete Wilson in October 1997.

The intent of the legislation was to investigate the feasibility and appropriateness of establishing a statewide environmental database and GIS mapping system. These tools would provide timely information to coordinate and support state agencies in protecting, from sources of motor vehicle fuel contamination, public drinking water wells and nearby aquifers that may reasonably be expected to be used as drinking water supplies. These bills directed the State Water Resources Control Board (SWRCB) to improve and expand its database of leaking underground fuel tank sites and to include analytical tools and GIS capability. Further, these bills required the SWRCB to test the feasibility of these new database and GIS capabilities by conducting two pilot projects for the Santa Monica and Santa Clara Valley areas to be completed by July 1, 1999. The legislation required the SWRCB to identify, within the pilot areas, all underground storage tanks (USTs) and all known releases of motor vehicle fuel from USTs that are within 1,000 feet of a drinking water well; it also required the State Fire Marshal Office to identify public wells within 1,000 feet of a petroleum product pipeline.

To assist the SWRCB in developing the pilot project, AB 592 and SB 1189 required the creation of an advisory committee, the GIS Mapping and Data Management Advisory Committee. The advisory committee consisted of representatives from agencies regulating leaking tank sites (the state and regional water boards), an agency regulating drinking water quality (the Department of Health Services, DHS), an agency regulating pipelines (the State Fire Marshal Office), the US Environmental Protection Agency (US EPA), municipal water suppliers, the petroleum industry, and a public environmental interest group (See Appendix A for a listing of members). They met with SWRCB and Lawrence Livermore National Laboratory (LLNL) staff on a monthly to bimonthly basis from January 1998 until June 1999. In addition, advisory committee meetings were open to the public to contribute their opinions and/or expertise.

2. Background

2.1. MTBE

The release of gasoline from leaking underground storage tanks has resulted in MTBE contamination of a small but significant number of public drinking water sources resulting in the closure of wells. Because MTBE is both more mobile and resistant to biodegradation than other components of gasoline, and because of the widespread distribution of gasoline releases containing MTBE, it is expected that additional drinking water sources will become contaminated in the future. In California,

more than 10,000 sites currently regulated as leaking tank sites have been estimated to have released MTBE to subsurface groundwater¹. On March 25, 1999, in response to a growing concern about the effects of MTBE on groundwater resources, Governor Gray Davis signed Executive Order D-5-99 which requires the SWRCB to expeditiously prioritize groundwater recharge areas and aquifers that are most vulnerable to contamination by MTBE and prioritize resources toward protection and cleanup.

2.2. Existing Management of Environmental Data

A recent audit by the California State Auditor (December 1998) concluded that the state has not adequately managed cases involving MTBE contamination of drinking water sources and underground storage tank sites. The auditors found that regulatory entities often do not have mechanisms to efficiently and effectively share information concerning gasoline releases and contamination in drinking water and that this lack of communication threatens water quality. For example, drinking water regulators (and municipal water suppliers) may not receive sufficient notification or details about contamination migrating toward drinking water sources. Likewise, contaminant site regulators (and responsible parties) may not receive well-specific information to determine if a leaking tank site is likely to contaminate a drinking water source, or may not be informed that gasoline compounds have been detected in a nearby drinking water source. Currently, regulatory agencies cannot identify leaking tank sites closest to the thousands of drinking water wells across the state due to a lack of accurate well location data, and therefore cannot use this information when they prioritize the investigation and/or remediation of these leaking tank sites. The auditors also noted that a standardized database, coupled with a GIS interface, could streamline the integration of data from multiple agencies (i.e., it could integrate data for contaminant sites and drinking water sources) and give all stakeholders access to tools to analyze data to estimate vulnerability.

Regulators (caseworkers) responsible for overseeing leaking tank sites cannot quickly access and analyze site data to make informed clean-up decisions, and other stakeholders only have limited access to this information. Each responsible party is required to submit periodic site reports. Frequently, large amounts of groundwater, soil, and site-specific data are collected and interspersed within numerous paper reports stored in various locations. Thus, it is extremely difficult for caseworkers to adequately review or analyze the immense amount of environmental site data currently required by regulations. Further, responsible parties and other stakeholders have even more limited access to this information. Electronic reporting of environmental compliance data by responsible parties can streamline the management of contaminant sites. However, Section 13360 of the Porter-Cologne water act severely restricts the SWRCB from stating a specific reporting format, such as electronic reporting.

2.3. Pilot Areas

The boundaries of the groundwater pilot projects included all of Santa Clara County and an area of Los Angeles County encompassing both the City of Santa Monica and the City's well fields. The City of Santa Monica has a population of approximately 89,000. Previously, the City drew groundwater from 11 wells in the Charnock, Arcadia, and Santa Monica well fields. After being impacted by MTBE, all the wells in the Charnock and Arcadia fields were closed, resulting in the loss of approximately 50

¹ Happel, A.M., E.H. Beckenbach, R.U. Halden; *An Evaluation of MTBE Impacts to California Groundwater Resources*; UCRL-AR-122207; Lawrence Livermore National Laboratory: Livermore, CA, 1998.

percent of the City's water supply, which averaged 13.6 million gallons per day. The City now imports replacement water at an annual cost of approximately \$3.25 million.

The Santa Clara Valley Water District (SCVWD), the main water district for the valley, supplies an estimated 98 million gallons of groundwater per day to over 1.7 million people through 16 municipal and industrial retailers and agricultural users. In contrast to Santa Monica, many wells in Santa Clara are private wells. Surface water is imported through the California Water Project, the Central Valley Project, and from the Hetch Hetchy Reservoir. During droughts, Santa Clara Valley must depend substantially on its own local groundwater and surface water supplies.

3. Pilot Project Findings

Finding 1. A standard data structure and common data elements are required to integrate SWRCB datasets and data from external sources to create a cost-effective GIS mapping system to manage cleanup of contaminated sites.

An extensive review of 8 databases² currently used to manage environmental data was performed to evaluate relevant data needs "to create a cost-effective GIS mapping system that will provide the appropriate information to allow agencies to better protect public drinking water wells and, if feasible, nearby aquifers that are reasonably expected to be used as drinking water, from contamination by motor vehicle fuels and underground storage tanks and intra- and interstate pipelines . . ."³ The intent was to examine the data tracked in each of these databases to identify the information most relevant to the overall legislative objectives defined by the Mapping and Data Management Advisory Committee.⁴

This review demonstrated that no one database tracked all relevant information needed to understand and manage contaminant sites. Ideally, a statewide system would contain both regulatory information and detailed information on contaminant sites and drinking water sources.⁵ Another important finding from this review was that many pieces of environmental data considered relevant to the objectives set forth by the AB 592 and SB 1189 legislation are not currently tracked in any state database.⁶ Further, when relevant information was collected and stored in state databases, sometimes conflicting

² Data elements were compared and evaluated among the following: SWRCB LUSTIS (Leaking Underground Storage Tank Information System) database, SCVWD's Felix (LUFT) database, SCVWD's Groundwater Monitoring database, the US Army Corps of Engineers Environmental Data Management System, H2O Komex Charnock and Arcadia GIS/database systems, LARWQCB and US EPA Region 9 LUFT database, and DHS's Permitting, Inspection, Compliance, Monitoring, and Evaluation (PICME) database, and DHS's Water Quality Monitoring database.

³ See AB 592 (<http://morrisson.lnl.gov/legislation/AB592.html>) and SB 1189 (<http://morrisson.lnl.gov/legislation/SB1189.html>).

⁴ See Appendix B for May 1998 meeting minute notes describing the project objectives developed by the Mapping and Data Management Advisory Committee.

⁵ Of the 8 databases examined, 3 focused mainly on tracking regulatory data, while 5 databases extensively tracked field sampling results and location-specific data including water quality, water level measurements, well construction data, and geographic data. In general there was considerable redundancy in data tracked between the regulatory databases and in some cases, significant overlap was found between types of field data tracked within the other databases.

⁶ For example: LUFT groundwater monitoring water quality data, UST construction and leak prevention data, depth to water measurements for groundwater monitoring wells, water system production and use data, lithologic and construction data for public wells, pumping capacity of public wells, data describing the screened interval of public wells, and accurate locations for public wells.

nomenclatures and definitions were utilized limiting the usefulness of the data. Most importantly, no state database was accessible via the Internet. To overcome these limitations, a database subcommittee⁷ was formed with the goal of defining a standard data structure and set of data elements. The intent was to use this data structure to store extensive contaminant site data, to warehouse information obtained from other external databases, and to store a broad set of environmental information that was not currently maintained in any state database. However, successful "warehousing" of data from external source databases on a regular basis will require the establishment of consistent, clear definitions in external source databases to ensure reliable transfer of high quality data.

Finding 2. Existing datasets for operating USTs, LUFT sites, and drinking water wells are mismatched and require reconciliation.

Operating USTs. Currently, there is no single statewide list of operating UST facilities. UST facility information is recorded by local agencies responsible for permitting of USTs and for issuing air quality permits to facilities that dispense motor vehicle fuels. To create an accurate statewide list of operating USTs, LLNL, in collaboration with the California Energy Commission, collected lists of operating UST site addresses from all local UST regulatory agencies and local air quality districts. Major inconsistencies were found in these listings of operating USTs.⁸ Neither the air quality district nor the local UST regulatory agency lists appear to be complete.

LUFT sites. LLNL inventoried LUFT sites situated in the Santa Clara Valley by examining leaking tank databases from the underground storage tank program of the SCVWD and the San Francisco Bay Regional Water Quality Control Board. This analysis showed that there were LUFT sites that could not be reconciled between the databases, demonstrating the need for more proficient mechanisms to track LUFT information.⁹

Public wells. LLNL inventoried public drinking water wells in the Santa Clara Valley by comparing well information obtained from the SCVWD and the DHS Permitting, Inspection, Compliance, Monitoring, and Evaluation (PICME) database. This analysis showed that significant numbers of public wells could

⁷ The database subcommittee reviewed and refined a "wishlist" of database elements organized into relational tables based on LLNL's evaluation of 8 environmental databases. A series of conference calls were made and documents were produced from August to December 1998. Participating members were: Roger Pierno (SCVWD), Thom Siebles (LARWQCB), Cliff Bowen (DHS), Jonathan Miller (Shell), Garrick Jauregui (Chevron), Lisa Thompson (Chevron), Lisa Anderson (MWD), Mark List (CVRWQCB), Jim Dodelson (Komet H2O Science), Rey Rodriguez (City of Santa Monica), Anne Happel (LLNL), Brendan Doohar (LLNL), Edwin Beckenbach (LLNL), Heidi Temko (SWRCB), Joe Devoy (Harding Lawson Associates)

⁸ Only 40 percent of the facilities in the Air Quality Management District (AQMD) lists and 45 percent of the facilities in the Certified Unified Program Agencies (CUPA) list can be confirmed on other lists of active tanks. The lists were reconciled by standardizing the address information and matching street number, street name and city fields in each list. Thirty-five percent of the CUPA sites and 19 percent of the AQMD sites could not be confirmed because the address information was incomplete or could not be standardized. Of the addresses that could be standardized, 3,199 (70%) of the 4,627 CUPA addresses could be confirmed on other lists, and 8,155 (50%) of the 16,073 AQMD addresses could be confirmed on other lists. The analysis was based on AQMD data from 31 of 35 districts, 70 of 104 CUPAs, a commercial listing of retail gas stations, and a major oil company list.

⁹ The LUFT sites from each database were reconciled by standardizing the address information and matching street number, street name and city fields in each list. Of the 2,063 records from SCVWD LUFT database, only 1,913 records could be reconciled to the SFBWQCB database. Likewise, this analysis shows that there are 211 records in the SFBWQCB database that could not be reconciled with the SCVWD records.

not be reconciled between the databases examined.¹⁰ A portion of this problem is due to the fact that the DHS PICME database uses an identification number¹¹ for public wells that is different than the assigned state well name utilized by other state and local agencies. Apparently because of delays in issuance of a state well name by the California Department of Water Resources (DWR), a significant proportion of PICME well records do not contain the state well name.

Finding 3. Current location data for public drinking water wells are inadequate for use by local and state agencies regulating contaminant sites.

The location of a well is an essential piece of data required to identify which leaking tank sites are closest to public drinking water wells and may pose the greatest threat of contamination. AB 592 and SB 1189 require the SWRCB to identify potential threats (e.g., LUFT sites) within 1,000 feet of a public drinking water well. Because of this, LLNL evaluated the quality of location information for drinking water wells maintained in the DHS PICME database. For this analysis, LLNL acquired high accuracy¹² location data for 1,206 drinking water wells and then compared these map positions to those in the DHS PICME database. This analysis estimates that only approximately 26 percent of the latitude and longitude data for public wells in the DHS PICME database were within 1,000 feet of the actual location,¹³ and 40 percent were in error by more than a half mile. Additionally, qualifiers in the PICME database intended to describe the accuracy of the water source position are not consistent; thus it was not possible to determine which water source positions were of high accuracy. As part of its Drinking Water Source Assessment and Protection Program, DHS will be completing a vulnerability assessment of over 16,000 active drinking water sources. DHS is committed to acquiring accurate well location information (less than 25-meter accuracy) by May 2003. In the meantime, the SWRCB and DHS are examining ways to quickly acquire more accurate well-location information (as described below in Accomplishment 4), particularly in vulnerable groundwater areas.

¹⁰ The public well records were reconciled by matching the assigned state well names from each database. Of the 532 public well records for Santa Clara County in the DHS PICME database, only 345 of these could be reconciled with the SCVWD database. 99 PICME well records did not use a standard assigned state well name and therefore could not be matched to the SCVWD records. Further, an additional 88 PICME well records that were identified by assigned state well names were not duplicated in the SCVWD records. Likewise, 196 records defined as public wells in the SCVWD database could not be reconciled with PICME well records.

¹¹ DHS identifies public water sources by established US EPA source identification numbers that DHS is required to report to US EPA. For 65 percent of public wells in the PICME database, the assigned state well name is also recorded in an additional identifying field (SOURCE_NO).

¹² LLNL obtained well locations from various local agencies and industry. 376 well locations were obtained by the SCVWD by mapping well locations onto an assessor parcel map. Orange County Water District obtained 264 well locations by digitizing wells onto 7.5 minute USGS quadrangle maps. Well locations in Los Angeles and Alameda Counties were obtained by Chevron using Global Position System (GPS) technology: 280 well locations with +/-100 meter accuracy and 286 well locations with sub-meter accuracy. A total of 1,206 improved locations were collected which represents approximately 8 percent of the 14,901 active public groundwater sources.

¹³ Well locations from the DHS PICME database were compared to local agency and industry data for 1,206 public well locations. The median error in the PICME database well location was estimated to be 2,251 feet.

Finding 4. Locations of LUFT sites and operating UST facilities can be determined with moderate accuracy based on commercial site addresses.

A high percentage of LUFT and UST sites have street addresses that can be geocoded¹⁴ to establish latitude and longitude data. For California, 84 percent of commercial addresses for LUFT sites produced "moderate" accuracy geocoded latitudes and longitudes with an estimated median error of approximately 396 feet.¹⁵

Finding 5. The well-specific information and regional hydrogeologic information needed to estimate the likelihood that a LUFT site will contaminate a drinking water well are not readily accessible.

While location information is a primary screening tool required to identify contaminant sites close to public water sources, other well-specific data is needed to understand the subsurface hydrogeology in order to estimate the potential effect a LUFT site may have on a well. Examples of well-specific data include the volume of water produced daily from the well, the zones within the well from which water is drawn (screened interval), and the hydrogeology of the area surrounding the well, including lithologic records. A portion of this information is maintained in paper files interspersed between DWR, DHS, and county offices. For example, well construction, lithology, and location data is submitted to the DWR on paper. In general, access to paper files is severely limited by minimal records staffing and confidentiality restrictions. Regional hydrogeologic information is typically not collected and integrated, yet can be useful for assessments of individual contaminant sites and regional water resources.¹⁶

Finding 6. Electronic submission and retrieval of data can easily be achieved with current technology and software.

The electronic submission and retrieval of environmental information was investigated. The technology of data reporting has matured to a point where Internet access allows the simple input, transfer, and quick retrieval of electronic data. Electronic submission of data with a uniform descriptive dictionary of terms and properly designed input forms will reduce recording errors and can substantially reduce the cost to enter the data into a standardized database.

4. Pilot Project Accomplishments

Accomplishment 1. A relational database, GEIMS, was created to uniformly store data needed for a statewide GIS mapping system.

After extensive review of numerous environmental databases, and with the assistance of the advisory committee, a standard relational database structure was created called Geographical-Environmental Information Management System (GEIMS).¹⁷ GEIMS was designed to serve both as a central

¹⁴ Geocoding finds latitude and longitude of street addresses using an electronic database of streets and returns a classification code describing the quality of the position.

¹⁵ Geocoded locations were compared to assessor parcel map locations of 2,152 LUFT sites in Santa Clara County. This analysis suggests that approximately 86% of all levels of geocoded LUFT site locations statewide are within 1,000 feet of the actual location.

¹⁶ Regional hydrogeologic information was integrated by SCVWD into a cohesive conceptual model and made available as a GIS layer. See "Confining Layers" in GeoTracker list of layers.

¹⁷ See Appendix C for the Entity Relationship Diagram of the GEIMS (pronounced "Jims") database. GEIMS is a relational database using Oracle, Inc. software.

database for the SWRCB to track contaminant site data and, similar to US EPA's Envirofacts, as a data warehouse to integrate information from several disparate agency databases at one time. This approach allows the SWRCB and other users to integrate and analyze information from multiple agencies in order to create reports and to produce data to generate visual maps. GEIMS can store location information about drinking water wells, LUFT sites, or any other contaminant releases to the subsurface. In addition to being designed to store extensive data related to underground tanks, GEIMS can store water-quality information, water-use information, and infrastructure data needed to assess both water supplies and any contaminant site.

For the pilot project, the GEIMS data structure was tested by populating the database with LUFT site and public drinking water well data for the Santa Clara Valley and Santa Monica pilot study areas. Regulatory data from the SWRCB LUSTIS (Leaking Underground Storage Tanks Information System), SCVWD Felix, SCVWD groundwater monitoring database, DHS PICME, and the DHS Water Quality Monitoring databases were reviewed, standardized and imported into GEIMS.¹⁸ Thus, the GEIMS database now contains information on LUFT sites and drinking water sources. Additionally, data from the SCVWD on public well yields, public well screen intervals, LUFT groundwater gradient magnitude and direction, depth to groundwater at LUFT sites, and LUFT soil and groundwater concentration data for MTBE, benzene, and total petroleum hydrocarbon (TPH) were imported into the GEIMS database.

Accomplishment 2. An Internet geographical information system called GeoTracker allows users to analyze data relationships, create reports, and generate maps of environmental data from multiple data sources.

GeoTracker's GIS and Internet capabilities are demonstrated by a set of online queries that allow users to query data from the GEIMS data repository for LUFT sites and public drinking water wells data for the Santa Clara Valley and Santa Monica pilot study areas from 5 separate databases.¹⁹ Further, GeoTracker enables users to integrate this information with coverages of fuel pipelines, active UST facilities, watersheds, groundwater basin maps, detailed street maps, and subsurface confining layers (Santa Clara Valley only). Based on these datasets, GeoTracker allows users to analyze data relationships, create reports, and generate maps of environmental data. For example, detailed reports on LUFT sites (Figure 1) or drinking water wells (Figure 2) can be generated with ease. GeoTracker²⁰ uses powerful, commercially available software²¹ that has been customized to allow users to easily interact with GEIMS over the Internet.

¹⁸ The total data stored in the database is approximately 250 MB of information for the two pilot areas, with the majority of the data imported from the highest quality source, SCVWD. LLNL recognizes that data quality will vary widely about the state, but expects a tool such as GeoTracker, with the future addition of Internet based input forms, to greatly expedite transfer of data and to help assure higher data consistency in the future.

¹⁹ SWRCB LUSTIS, SCVWD Felix, SCVWD groundwater monitoring database, DHS PICME, and DHS WQM.

²⁰ Construction of GEIMS and GeoTracker required approximately two man-years to reach the current status. The upkeep of a working system, including new queries that may be required for regulatory and other stakeholders, would require substantially less time and effort.

²¹ The software used to create GeoTracker is ESRI's MapObjects (<http://www.esri.com/>). The software used for reporting the GEIMS database is Allaire's ColdFusion (<http://www.allaire.com/>).

GeoTracker will allow regulatory personnel, responsible parties, and all stakeholders efficient access to the same data and the choice of a common set of analysis tools, resulting in less duplication of effort and improved communications. Users will include regulatory agency personnel, water suppliers, representatives of oil companies, responsible parties and their consultants, environmental public interest groups, and the public at large.

Accomplishment 3. GeoTracker can analyze the relationship between LUFT sites and wells to generate maps describing aspects of vulnerability.

The tools built into GeoTracker can quickly identify and display the number of wells within various distances of LUFT sites and the number of LUFT sites within various distances of wells (Figure 3). To increase ease of use, Internet "hot links" are provided to produce summary reports about the wells closest to LUFT sites or LUFT sites closest to wells (Figures 1 and 2).

Advanced GeoTracker tools allow users to integrate well-specific and contaminant site-specific information, thereby enabling users to analyze various aspects of vulnerability.²² For example, GeoTracker online queries can delineate the protection area surrounding a well using either a fixed radius method or the calculated fixed radius method being utilized by the DHS Drinking Water Source Assessment and Protection Program. The user can display UST facilities, LUFT sites, and pipelines in these delineated areas (Figure 4). Because the Mapping and Data Management Advisory Committee felt that no single analytical method would be sufficient for all stakeholders, a set of analysis tools was developed, thereby avoiding a single "state-sanctioned" vulnerability method.

Accomplishment 4. Rapid interim improvements in the location data for public drinking water wells were demonstrated.

Because of the Governor's Executive Order D-5-99, rapid improvement in the locations of water sources is needed by caseworkers to focus efforts on fuel release sites closest to public water sources in highly vulnerable areas. While DHS is committed to gathering accurate (less than 25 meter) positions of public wells, accurate well positions are needed before the completion date of May 2003. On a statewide basis, LLNL has improved the accuracy of public water supply wells from the DHS PICME database that utilize the standard DWR well-naming convention.²³ After repositioning, 73 percent of these public wells were estimated to be within 1,000 feet of actual location; 98 percent were estimated to be within one-half mile of actual location.²⁴

While this level of accuracy is sufficient for regional or statewide analysis, the improvement in location accuracy is still insufficient for use by caseworkers and responsible parties. To further refine location accuracy until precise Global Positioning System (GPS) field measurements are obtained, LLNL has developed a GeoTracker tool that allows users to quickly locate and reposition the well using geo-referenced base maps and to record the new information automatically in the GEIMS database.

²² The Advanced GeoTracker query page is accessed from the GeoTracker front page (<http://geotracker.llnl.gov/>).

²³ 14,600 public wells statewide, for which there are assigned DWR state well names recorded in the DHS PICME database, were repositioned by LLNL to the centroid of the quarter-quarter section of a Public Land Survey Township-Range grid developed by the California Department of Forestry.

²⁴ For this analysis, LLNL improved well locations were compared to the previously described 1,206 high accuracy well locations obtained from local agencies and industry (see Footnote 11).

Currently, GeoTracker uses highly accurate Etak²⁵ roadmaps; the advisory committee has also advocated the addition of United States Geological Survey topographical quadrangle maps. LLNL and the DHS jointly performed a test of a prototype well-positioning tool for public wells in the San Gabriel Basin²⁶ and are currently gathering precise location information for these wells to quantify the effectiveness of this tool.

Accomplishment 5. The GEIMS database accepts electronic submission of analytical field sampling data reported for contaminant sites.

The GEIMS database was designed specifically to accept electronic analytical chemistry information in Electronic Data Format. Electronic Data Format is a standard data environmental quality submittal format, developed by the Army Corps of Engineers, that is already being used by many commercial laboratories throughout the state and the Pacific Northwest. This software is in the public domain and is maintained and updated every two years through an Electronic Data Format users group by the Army Corps of Engineers.²⁷

For other data, such as depth to groundwater data, electronic input forms can be easily developed to feed this information directly into the GEIMS database.

5. Conclusions and Recommendations

There is an urgent need to change the way California agencies manage environmental data. With the invention of the Internet, the once difficult-to-near-impossible task of accessing data from various agencies for thousands of contaminant sites or public wells can be made simple. A standardized database (GEIMS) has been created, populated with environmental data from multiple agencies within the two pilot project areas, and made accessible over the Internet using GeoTracker. Based on this pilot project, the feasibility of establishing a statewide system has been demonstrated. GEIMS/GeoTracker are powerful tools enabling users to store, collect, retrieve, analyze, and display environmental geographic data with relative ease and is available to the public over the Internet. GEIMS, which was designed to deal with any contaminant site and its effect on water resources, can act as an important hub for integrating information from multiple agencies about contaminant sites and water resources. Thus local and state agencies managing contaminant sites, as well as all other stakeholders, will have efficient access to each other's data, thereby increasing communication and creating the foundation of a consistent management framework.

²⁵ Etak, Inc., headquartered in Menlo Park, specializes in high-quality digital map databases (<http://www.etak.com/>).

²⁶ 71 public well locations in the San Gabriel Basin in Los Angeles County, representing 12 water agencies, were repositioned. Ten DHS engineers spent a total of 15 hours, an average of 13 minutes per well, to gather detailed engineering maps (available for 34 sites), written location descriptions (available for 6 sites), site addresses (available for 62 sites), and large scale maps (available for 17 sites). Currently within the District office, Internet access is limited to phone-modem connections and is only available on three computers. The well location repositioning was performed by the LLNL staff member and then verified online by DHS staff. 73 percent of the well locations were moved by more than 1,000 feet and 50 percent of the well locations were moved by more than 1/2 mile.

²⁷ DHS has suggested using the US Army Corps of Engineers CE Electronic Data Format for its water quality data submission, personal communication from Cliff Bowen to the advisory committee.

The pilot project system has been designed to be easily expanded statewide. Implementation by the SWRCB of a statewide system will dramatically increase the ability for contaminant site regulators and environmental consultants to access, review, and analyze environmental data. A statewide system has the potential to minimize the threat of leaks from underground fuel tanks (or other contaminant sites) to drinking water sources by providing a means to prioritize sites that are closest to public water sources. Implementation of a statewide system will result in contaminant and water resource management tools that can dramatically transform the way contaminant site regulators and industry make cleanup decisions and establish priorities for managing cleanup. A statewide system will improve water resource management by allowing data to be integrated quickly into the process by which cleanup management decisions are made.

Recommendation 1. The SWRCB should expand the GEIMS/GeoTracker system to a statewide basis.

To fulfill the Governor's Executive Order of expeditiously prioritizing groundwater recharge areas and aquifers that are most vulnerable to contamination by MTBE, the pilot projects should be extended to a statewide basis. Specifically, statewide regulatory compliance data from the SWRCB LUSTIS, DHS PICME, and the DHS Water Quality Monitoring databases should be reviewed, standardized, reconciled with local agencies, and imported into GEIMS. Likewise, coverages of watersheds, groundwater basin maps, and detailed street maps are currently available statewide and should be incorporated. The SWRCB should work with local agencies to produce coverages identifying subsurface confining layers and recharge areas, especially in areas with high densities of LUFT sites that rely substantially on groundwater for drinking water. The SWRCB should also work with local agencies to produce a coverage identifying active UST facilities. GeoTracker will provide state and local agencies with immediate access via the Internet to this information.

Recommendation 2. The accuracy of well location data needs to be significantly improved within a one-year time frame.

To fulfill the Governor's Executive Order of expeditiously prioritizing groundwater recharge areas and aquifers that are most vulnerable to contamination by MTBE necessitates the availability of accurate well location information. Accurate well locations should be obtained first in areas that contain a high density of LUFT sites and rely heavily on groundwater for a drinking water supply. In the absence of high accuracy GPS measurements, the use of the Internet GeoTracker tool that is designed to produce rapid and cost-effective improvements in well locations should be investigated to expedite this process.

Recommendation 3. State and local agencies should investigate the opportunity to benefit from the SWRCB's implementation of GEIMS/GeoTracker.

Although the database structure (GEIMS) and the Internet GIS Interface (GeoTracker) were designed for the SWRCB to better protect water resources from MTBE contamination, this system may present opportunities for other state and local agencies. The GEIMS/GeoTracker system is in the public domain. The database provides the ability to logically track many pieces of environmental data that are not currently tracked or held in an electronic format by other agency databases. The SWRCB should consider the use of GEIMS/GeoTracker to manage other types of groundwater contamination. Local and state agencies will benefit from a single, consistent listing of contaminant sites and potentially contaminating activities, reducing tracking efforts throughout the state. Likewise, DWR may see opportunity in the SWRCB GEIMS/GeoTracker system to efficiently assign state well numbers,

and to record and maintain well construction data, geological data, water production and usage data, and groundwater quality monitoring data.

In a statewide implementation phase, the SWRCB should consider forming a users group so that feedback and input from users, including other participating agencies, will be integrated into future development and maintenance efforts, and to take advantage of new technologies.

Recommendation 4. The SWRCB should add electronic reporting to the GEIMS database.

Electronic reporting is essential for the successful implementation of a statewide system. Online input forms should be added to GEIMS to electronically submit contaminant site compliance data as it enters the regulatory system. This will provide seamless integration with the GeoTracker data warehouse giving state and local agencies immediate access to contaminant site data. Legislation is needed for the SWRCB to require electronic reporting. Until this occurs, the SWRCB should begin voluntary electronic reporting.

Recommendation 5. External agency databases should provide regular high quality updates to the data repository.

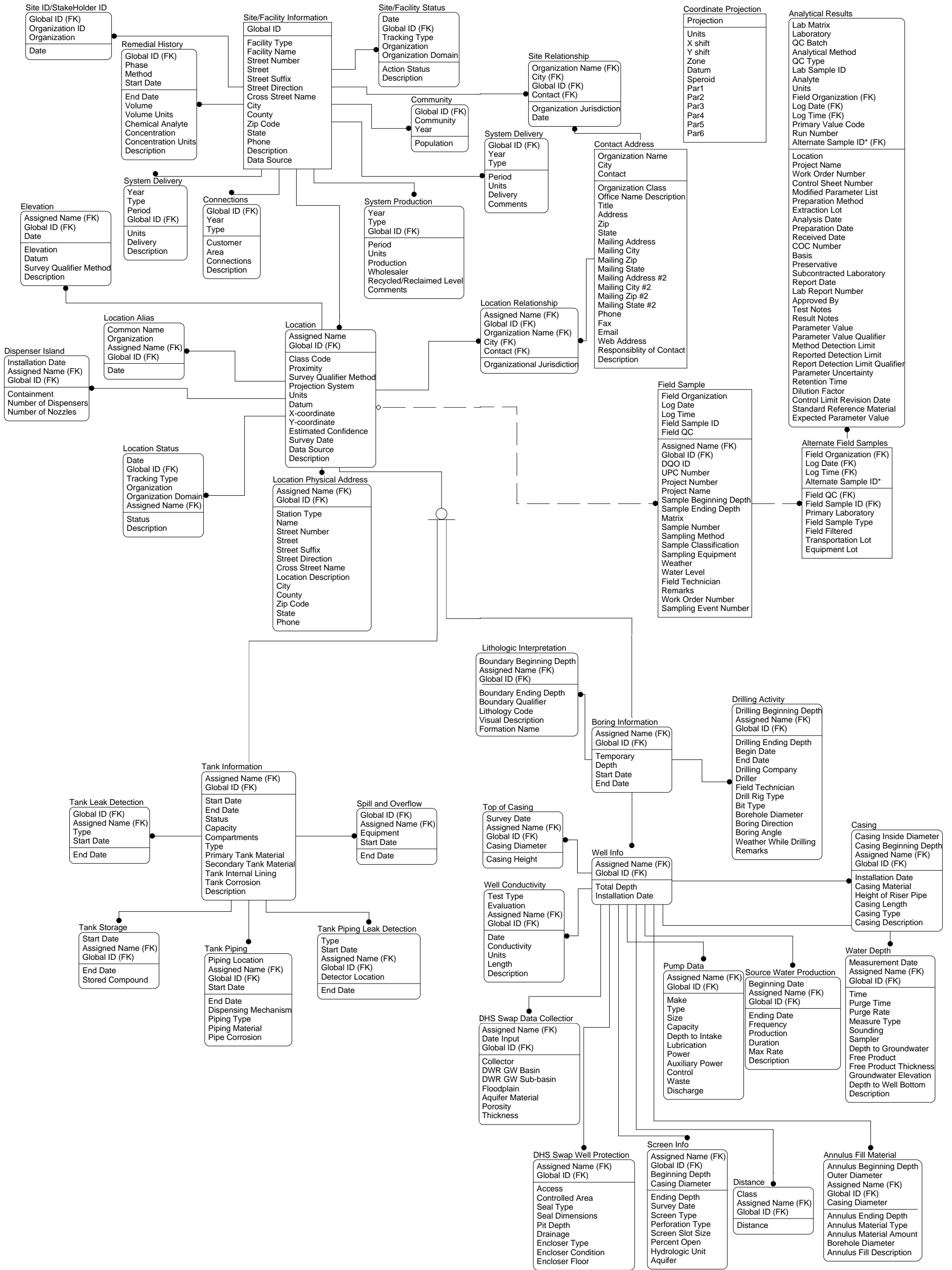
For data to be successfully warehoused in the SWRCB data repository, external databases need to provide clear and consistent definitions of data elements and tables, and provide logical checks restricting the values of each data element upon data entry. Further, agencies responsible for external data sources should work with the SWRCB to ensure both that the definitions of data elements are sufficient, and that data maintained is comprehensive enough to meet the needs of the SWRCB to effectively manage LUFT site cleanup.

Recommendation 6. Existing datasets for operating USTs, LUFT sites, and public drinking water wells should be reviewed and reconciled.

The SWRCB should work with local agencies to compile in the GEIMS database a single, accurate statewide list of operating USTs. The SWRCB should work with agencies responsible for overseeing cleanup of leaking tank sites to reconcile data in the LUSTIS database versus local records. The DHS should routinely record assigned state source names in a timely manner within the PICME database to avoid confusion with local and other state agencies. Likewise, DWR should create an on-line Internet input form to quickly and accurately assign a state well name, record location information electronically, and make this information easily accessible to local and state regulatory agencies and other users.

Recommendation 7. DWR should be granted sufficient authority to distribute, when necessary, water well construction and geological information electronically.

To expedite environmental and water resource investigations, the DWR should be granted the authority to allow geological and well construction data to be viewed by other regulatory users and/or by other stakeholders, and recorded and maintained electronically.



Appendix C:
Geographic Environmental Information Management System (GEIMS)
Database Entity Relationship Diagram